Joining of Sheet Metals by Impulsive Riveting Method and Punching Rivet Method

Hiroyuki KINOSHITA1*, Koichi KAIZU2, Kiyohiko IKEDA1, Takefumi NAKAZONO1, Taichi KOBAYASHI3, Hanako FUKUYAMA3

1Faculty of Engineering, University of Miyazaki, Gakukenkibanadai-nishi, Miyazaki City, 889-2192, Japan
2Department of Mechanical and System Engineering, University of Hyogo, Shosha, Himeji City, 671-2280, Japan
3Miyazaki TLO, Gakuen-Kibanadai-Nishi, Miyazaki City, 889-2192, Japan

*tn0165u@cc.miyazaki-u.ac.jp

Keywords: Machine Element, Punching Rivet Method, Impulsive Riveting Method, Caulking, Joint Strength

1. Introduction. Authors have proposed the impulsive riveting method(1). In the method, both of the rivet which is similar to a usual rivet shape used in riveting and the rivet holder are used, and punching of the sheets and joining are simultaneously carried out using the impulsive energy of the weight accelerated by an air compressor. The impulsive riveting method has many excellent features(1), but it needs the large equipment in order to utilize the impulsive energy and the control of the impulsive energy is very difficult. Therefore, in this study, the development of the punching rivet method that could join the sheets by pressing the rivet and punching out the sheets was attempted and the method was applied to joining of cold-reduced carbon steel sheets. Firstly, it was shown that the sheets could be joined by the proposed method. Next, the deformation and the strength of the joints were examined in comparison with those of the joints made by caulking and the impulsive riveting method. The usefulness of the punching rivet method in joining of sheets was clarified from obtained experimental results.

2. Experiments. Fig.1 shows the shape and dimensions of the joint made in this study. Cold-reduced carbon steel sheets (SPCC-SD) with thickness of 0.8mm were joined by the punching rivet method, the impulsive riveting method and caulking. Fig.2 shows the shapes and dimensions of a rivet and a rivet holder for the punching rivet method and the impulsive riveting method. A rolled steel for general structure (SS400) was used for the rivet material and the rivet holder. Fig.3 shows the schematic illustrations of the punching rivet method. The method was carried out by the following process: 1) Two sheets without holes were set on the die. The rivet was set on two sheets. And then the rivet axis was pushed into the sheets by pressing the rivet. 2) The rivet axis punched out the sheets and entered into a hole of a rivet holder. The rivet axis and the rivet holder were joined by the plastic deformation of the rivet axis. The sheets were tightened by the head of the rivet and the rivet holder.

3. Results and Discussions. Fig.4 shows the joints made by the punching rivet method and the impulsive riveting method. It is found that the steel sheets without drilled holes can be joined by the punching rivet method. Fig.5 shows the comparison of the joint strength. The strength of the joint made by the punching rivet method was nearly equal to those of the joints made by the impulsive riveting and the caulking.

Reference

Fig.1 Dimension of joint

Fig.2 Rivet and rivet holder

Fig.3 Punching rivet method

Fig.4 Joint made by punching rivet method and impulsive riveting method

Fig.5 Joint strength